R & D facts

U.S. Department of Energy
Office of Fossil Energy
National Energy Technology Laboratory

Office of Research and Development

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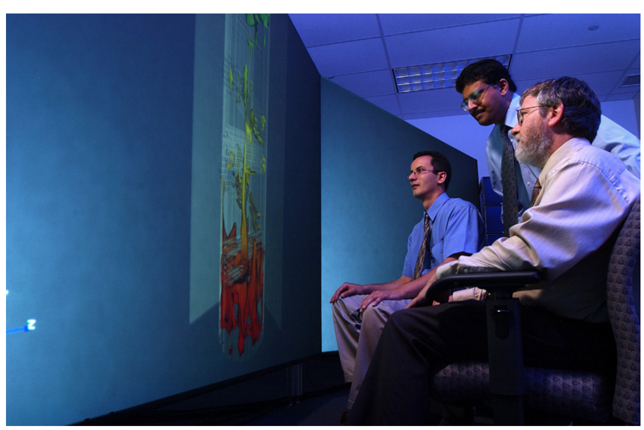
MFIX Wins 2006 Technology Transfer Award

Description

The Federal Laboratory Consortium (FLC) Mid-Atlantic Region presented a 2006 Excellence in Technology Transfer Award to the U.S. Department of Energy's (DOE) National Energy Technology Laboratory (NETL) for innovative efforts in transferring the software Multiphase Flow with Interphase eXchanges (MFIX) to the universities and industry. Advanced power plant technologies require multiphase reactors for processing fossil fuels; for example, coal (solids-phase) is reacted with steam and air (gas-phase) in a gasifier. The scale up of such multiphase reactors is notoriously difficult; engineers cannot reliably predict commercial-scale (large) reactor performance merely based on pilot-scale (small) reactor performance. NETL has been conducting research for many years to solve this problem and that effort has resulted in the development of MFIX, software for developing physics-based models.

Technology Transfer

Two technology transfer processes were used. First, through a collaborative project NETL researchers have been using MFIX to simulate the transport gasifier at the Power Systems Development Facility, Wilsonville, Alabama, operated by Southern Company and Kellogg Brown & Root (KBR). The simulations convincingly showed that the model does not merely reproduce what is already known, but provides insight into unobserved phenomena, which the engineers could later experimentally verify. Also MFIX was used to predict the expected gasifier behavior almost a year before certain design modifications were completed. MFIX simulations are being used to help in the design of a commercial-scale gasifier at Orlando, Florida.



NETL Research Engineers Review MFIX Results

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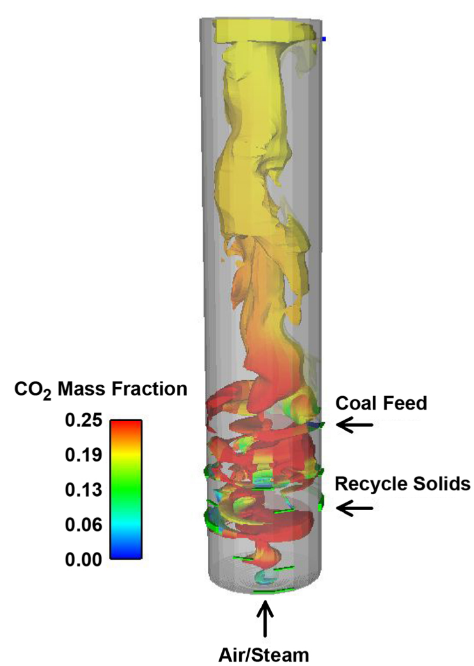
Second, MFIX was made available as open-source software for registered users. Because many users can watch and participate in the development of the software, the capabilities and quality of MFIX has been greatly enhanced. Also the use of MFIX has gone beyond its originally intended applications, primarily fluidization, to others, such as the simulation of industrial and natural processes.

Outcome of Technology Transfer Efforts

The technology transfer effort: (1) created a better method for designing gasifiers by incorporating the results of computational multiphase flow at the design stage as evidenced by the Southern Company/KBR project, (2) established the open source methodology for promoting research and graduate student training and for disseminating information on computational multiphase flow; for example, a numerical technique developed by Iowa State University using MFIX has been transferred to commercial software and was used for a commercial polyethylene reactor simulation, (3) promoted the use of computational multiphase flow in non-fossil fuel applications such as for Yucca Mountain Project or nuclear fuel particle coating reactor modeling. The open-source technology transfer has made it possible for some of the brightest people working in the multiphase field in power plants and other industries to shape the code for specific purposes; as a result, the value of the MFIX code has been recognized and utilized by a broad field of researchers from academia and industry.

The Southern Company/KBR project resulted in a new way of designing gasifiers by using MFIX methodology at the design stage. This has the potential to significantly reduce the risk in the commercial-scale design. The existing methodology is to use pilot-plant data to develop design correlations, which are then used to design the larger commercial scale unit. It is well documented that for gas-solids reactors this scale-up methodology is very unreliable. The physics-based model in MFIX, once validated with data from pilot-scale unit, gives more reliable predictions about the performance of commercial-scale reactors. Furthermore, MFIX calculations give detailed information about the flow field, pressure, temperature, and species distribution in the gasifier that enables the engineers to not only make incremental improvements to an existing design but also discover and explore new designs. For example, engineers at Southern Company/KBR are using the model to understand the impact the exit configuration has on syngas composition, the effect of reactor height on CO production, how the coal enters the reactor, how gas temperature varies inside the reactor, and the effect of increasing the pressure. As this is an emerging technology, actual cost savings figures are not available. It has been estimated that the use of such technology in commercial-scale gasifier design will result in savings of the order of $10 million per gasifier.



Transport gasifier model: Solids volume fraction isosurfaces colored by CO_2 mass fraction